Project Narrative

The Arsenal Project
Arsenal Street
Watertown, MA 02472

Prepared for:

Boylston Properties
800 Boylston Street, Suite 1390
Boston, MA 02199

and

The Wilder Companies
800 Boylston Street, Suite 1390
Boston, MA 02199

Prepared by:

RJ O'CONNELL & ASSOCIATES, INC.
80 Montvale Ave, Suite 201
Stoneham, MA 02180

Date:

July 11, 2016

The Arsenal Project

Project Narrative

per Section 9.03 of the Site Plan Review Submission Guidelines

1. ***Landscape:*** *The landscape shall be preserved in its natural state, insofar as practicable, by minimizing tree and soil removal, and any grade changes shall be in keeping with the general appearance of neighboring developed areas. Adequate landscaping shall also be provided, including screening of adjacent residential uses, provision of street trees, landscape islands in the parking lot and a landscape buffer along the street frontage.*

   The project landscape provides an increase of pervious open space to what is currently a very impervious site condition. Multiple open space areas of various sizes will be provided, including a large green space providing potential connectivity to the existing Arsenal Park. Adequate landscaping will be provided to establish comfortable streetscape conditions while also providing acceptable screening of necessary utilities and service areas. A variety of deciduous street trees will be used throughout the site and in the parking areas, while a mix of deciduous and evergreen trees will be used along buffered property edges.

2. ***Relation of Buildings to Environment:*** *Proposed development shall b e integrated into the terrain and the use, scale and architecture of existing buildings in the vicinity and shall be in accordance with the Comprehensive Plan or other plans adopted by the Town guiding future development. The Planning Board may require a modification in massing so as to reduce the effect of shadows on abutting property in all districts or on public open space.*

   The project entails seven buildings; two existing buildings with historic characteristics and five new buildings. A significant aspect of the project is the proposed demolition of a 1980's addition. The removal of this structure enables vehicular and pedestrian movement to occur more logically and to connect the site visually and physically to the Arsenal Park.

   The five new buildings have been sized and located to enable new pedestrian oriented streets and gathering spaces to be created between them. At grade in most locations, retails uses will be located to activate the public realm. Floors above are mainly residential dwelling units. Two of the buildings will include above ground parking decks.

   Careful attention has been paid to the spaces between buildings to consider proportions of width to height, creating comfortable, spacious, yet intimate gathering places.

   All buildings comply with setbacks as required by the RMUD zoning regulations, and utilize breaks in the forms and massing to soften their visual impact on the surrounding areas. Opening breaks in the façade at grade enable pedestrians to pass in the public spaces beyond.

3. ***Open Space:*** *All open space required by this Zoning Ordinance shall be so designed as to maximize its visibility for persons passing the site, encourage social interaction, maximize its utility, and facilitate its maintenance.*

   Greater than 20% of the site has been dedicated to open space. As noted in the Landscape Narrative, the open space consists of green space as well as enlivened public sidewalks and plazas. These areas will provide seating and dining areas, open areas to meet and entertain, and provides access to proposed retail, housing, and entertainment developments as well as adjacent parklands. The design planning of all open spaces will include dimensions for movement as well as gathering. See Open Space Figure and Interior Open Space Figure attached.

4. ***Circulation:*** *Special attention shall be given to traffic circulation, parking areas and access points to public streets and community facilities in order to maximize convenience and safety of vehicular, bicycle and pedestrian movement within the site and in relation to adjacent streets.*

   The project design incorporates many principles of smart growth by providing a concentrated mix of uses, sustainable transportation choices, shared parking and multiple site connections for convenient circulation. Within the area surrounding the site, there are multiple choices of recreation, work, shopping and housing. Live – work – play in one area allows for shared trips reducing the impacts on the roadway infrastructure.

   With respect to site circulation, site access and egress is provided via two signalized intersections with Arsenal Street, a right-in/right-out only driveway and an entrance only driveway. This allows for traffic to disperse entering and exiting the site.

   Parking is provided in a mix of surface lots, subsurface parking areas, and parking garages. Due to the multiple uses, on-site parking supply will be shared reducing the overall need for parking. For example, residential and some of the entertainment uses peak during the evening hours, while other retail and restaurant uses peak during the day or earlier in the evening allowing the uses to "share" parking. The parking areas will also have compact car spaces, carpool spaces, electric car charging stations and car-share spaces.

   Non-auto modes of travel will be emphasized with the project design to encourage bicycle, pedestrian and transit usage. The Watertown Greenway is a multi-use path and provides connections to recreational and shopping opportunities in the area. The Watertown Greenway was completed in 2010 and traverses the area between Arsenal Street and Arlington Street. A bicycle connection is planned on-site to connect the Arsenal Park to the Watertown Greenway. In addition, Arsenal Street is designated as a bicycle route with "share the road" signs along the street.

The site design will encourage pedestrian travel throughout the site with multiple sitting areas, pocket parks and connections to Arsenal Street. Major site design elements include connections to the Arsenal Park which connect the site to the recreation uses and pedestrian ways. A pedestrian connector is also planned from the Arsenal Project to Greenough Boulevard.

Convenient MBTA bus service is provided along Arsenal Street with multiple bus stops located along the frontages. The Arsenal Project will encourage transit usage by providing MBTA pass sales on-site. Maps and promotional material will also be provided on-site at a convenient centralized location.

The Arsenal Project will also be a founding member of the, to be established, Watertown Transportation Management Association (TMA). Services provided by the TMA will include shuttle service, Emergency Ride Home Program, ride matching program, carpool vanpool matching, bicycle/walk support resources, bicycle awareness and repair days and a newsletter to members encouraging alternative modes of travel.

The area is also under significant study by the Town of Watertown, MassDOT, and the MBTA and the Arsenal Project has been in attendance at the study meetings and has shared relevant information with respect to the project and is supportive of the study efforts.

See Fire Truck Maneuvering Figure, WB-50 Maneuvering Figure and Context Map attached.

5. ***Surface Water Drainage****: Special attention shall be given to proper site surface drainage so that removal of surface waters will not adversely affect neighboring properties or the public storm drainage system. Proposed developments shall seek to retain storm water runoff on the site to the maximum extent possible, incorporating best practices in storm water management and Low Impact Design techniques. In cases where storm water cannot be retained on site, storm water shall be removed from all roofs, canopies and paved areas and carried away in an underground drainage system.*

The proposed stormwater management system for the redevelopment includes measures for collecting, controlling, and treating stormwater runoff from the site. The drainage improvements proposed herein will reduce stormwater runoff peak flow rates and volumes leaving the site, increase groundwater recharge, and improve storm runoff water quality. The proposed measures under the redeveloped conditions comply with the Massachusetts Stormwater Handbook and the Town of Watertown's Requirements for Stormwater Management and Erosion Control to the maximum extent practicable, and represent an improvement over pre-redevelopment conditions. The proposed modifications include the following improvements:

1. **The proposed stormwater management system has been designed to reduce peak discharge rates and volumes. Subsurface Infiltration System 1 (SSI-1), which is located at the north side of the site and will discharge to the Town's 30-inch drain line in Arsenal Street, has been designed to detain and infiltrate the 25-year Cornell extreme precipitation storm until the HVMA lease expires, when a new subsurface infiltration system can be constructed on that parcel. After construction of the new subsurface infiltration system, SSI-1 will provide a 95% reduction of the peak flow rate and a 97% reduction of the total runoff volume for the 100-year Cornell extreme precipitation storm at Point of Analysis 1 (POA-1). The area and CN of the watershed that discharges runoff to Point of Analysis 2 (POA-2) will be reduced until a new subsurface infiltration system can be constructed on the HVMA parcel, which will result in lower post-redevelopment peak discharge rates and volumes compared to pre-redevelopment rates and volumes. After construction of the new HVMA subsurface infiltration system, the entire watershed discharging to POA-2 will be directed to subsurface infiltration systems and no runoff will be discharged from the site at POA-2. Finally, Subsurface Infiltration System 2 (SSI-2), which is located at the southeast corner of the site and will discharge to the Massachusetts Department of Conservation and Recreation (DCR) drainage system in Greenough Boulevard, has been designed to detain and infiltrate the 1-inch water quality volume over the impervious area within the proposed watershed. This will significantly reduce post-redevelopment peak discharge rates and volumes compared to pre-redevelopment rates and volumes at Point of Analysis 3.**

2. **The water quality of the site will be greatly improved under proposed conditions. The stormwater best management practices (BMPs) to be implemented on site include street sweeping, deep sump and hooded catch basins, CDS oil/particle separators, and subsurface infiltration basins. The total TSS removal for these BMPs at Points of Analysis 1 and 3 is 97%, and there will ultimately be no discharge from the site at Point of Analysis 2. With the exception of a few small surface lots, most parking will be provided in subsurface and above-ground garages, protected from exposure to rain, snow, snowmelt, and stormwater runoff, significantly reducing the discharge or stormwater with higher potential pollutant loads from the site.**

3. **A Stormwater Pollution Prevention Plan (SWPPP) and an Operation and Maintenance Plan (O&M) will be provided so the proposed improvements and treatment measures are effective during, and after the completion of construction activities.**

6. ***Utility Service:*** *Electric, telephone, cable TV and other such lines and equipment shall be underground. The proposed method of sanitary seage disposal and solid waste disposal from all buildings shall be indicated.*

The existing Arsenal Mall, adjacent HVMA building, located on Lot 2A, and the adjacent Condo building #216, are served by utilities located in Arsenal Street to the north of the site and Greenough Boulevard the south. The utility services for the proposed project will remain the same for the HVMA building and the Condo building will remain the same for the proposed development program.

A new underground primary electric duct bank system will be installed throughout the site to service each building of the Project. The duct bank system will consist of concrete encased conduits, manholes, transformers and switchgear as necessary based upon NSTAR Electric's requirements. Service will be provided from an existing underground duct bank located in the access drive on the west side of the site. Telephone and cable will be provided similarly and coordinated with each provider.

Two existing, separate 10-inch water mains loop the Home Depot and Arsenal Mall sites. The Arsenal Mall loop will be replaced with a new 10-inch loop with two new connections off the 12-inch water main in Arsenal Street. The loop will be installed in the main drive aisles and will supply fire protection and domestic water to the proposed buildings. Existing buildings will continue to be supplied by existing service lines. The loop will be sectionalized with zone control values and interconnected with the Home Depot loop. New hydrants will be installed throughout the site to provide adequate fire protection coverage.

Fire flow tests have been conducted on each of the existing loops to quantify existing fire flows. The tests indicated sufficient flow and pressure in both loops and resulted in fire hydrants classified as AA (1500 gpm or greater capacity at 20 psi residual pressure). See Hydrant Flow Test memo in the Appendix.

Eight (8) inch polyvinyl chloride (PVC) sewer mains will be installed in the access drives on the site to service proposed buildings. Sewers will flow by gravity in a northerly direction and connect to the 12-inch sewer in Arsenal Street. Sewage from Existing Building A, part of proposed Building F and proposed building G will flow by gravity in an easterly direction into the existing sewer along the east side of the site adjacent to the Home Depot property and discharge into the 15-inch sewer in Greenough Boulevard (see Sewer Flow Generation Table in the Appendix). Building plumbing has not been finalized however, there is sufficient capacity in the 12-inch sewer in Arsenal Street to accommodate all sewage from the proposed project (see Sewer Capacity Calculations in the Appendix). Service connections to proposed buildings will be a minimum of 6-inch diameter and will connect to the new sewer at manholes on the main sewer line. Separate waste lines will be provided for all restaurants and food handling facilities and exterior grease tanks will be installed on kitchen waste lines to intercept and separate grease, minimizing the potential for impacting sanitary sewers. Runoff from rain and snow melt from cars parked in the proposed above and below ground parking garages, not exposed to the environment, will discharge to the sanitary sewer in accordance with the Massachusetts Plumbing Code. Oil/water separators will be provided for pretreatment of this wastewater prior to discharging to the sanitary sewer in accordance with State and MWRA regulations.

Trash and recycling will be disposed of in proposed dumpsters located at the southwest corner of Building A, the southwest corner of Building B, the east side of Building C and D, the south sides of Building E and Building F, and the north side of Building G. The areas will be located within a screened enclosure, and managed by a private waste management contractor.

7. ***Environmental Sustainability:*** *Proposed developments shall seek to diminish the heat island effect; employ energy conscious design with regard to orientation, building materials and shading; utilize energy-efficient technology and renewable energy resources; and minimize water use.*

The proposed Arsenal Mall Redevelopment project in Watertown, MA will be sustainably designed, constructed and operated and will seek to limit negative effects on the local and global environment and existing municipal infrastructure.

The project is located in an existing urban environment within close proximity to many local services and easy-to-access public transportation. These factors can help to reduce the number of vehicular miles travelled in Watertown and the surrounding communities which contributes to the location desirability and helps minimize car travel in the neighborhood and adjacent areas.

As indicated in Section 5, a comprehensive stormwater management system will be designed and implemented for the development site. Site stormwater runoff will be directed to catch basins, treated and discharged to an extensive recharge system.

A significant amount of vegetated and pedestrian oriented open space will be provided to allow for permeability, biodiversity and walkability. Additionally, native and adaptive plant species will be specified and planted to reduce the demand for potable water for irrigation needs.

Heat island effect will be minimized through the use of landscaping, light colored pedestrian walkways/sidewalks, light colored roof materials and centralized parking garages.

The new construction projects will incorporate sustainable design measures including high performance building envelopes, and high efficiency mechanical, plumbing, and lighting systems that will enable the buildings to meet or exceed local energy code requirements. The owner plans to engage a third party commissioning agent to review the design documents, mechanical equipment submittals, systems installations and to ensure the owner's project requirements are met.

During construction, an Erosion and Sedimentation Control Plan will be implemented to prevent the loss of soil and sedimentation into the nearby Charles River and the municipal stormwater system, and to prevent pollution of the air with dust and particulate matter. Additionally, the contractor will divert a minimum of 75% of the construction and demolition waste from area landfills; it will be delivered to local sorting facilities for recycling.

The two existing historic arsenal buildings shall remain with minimal modifications. The design team will specify materials that have recycled content and are regionally obtainable to the extent possible.

The interior environments will include low emitting finish selections to limit negative effects on the indoor environment and human health. The residential units will have operable windows and ample access to daylight and views.

Several buildings within this development may be registered with the United States Green Building Council, (USGBC), and some may pursue Leadership in Energy and Environmental Design, (LEED) certification under version 3 of either the New Construction (LEED-NC) or Core and Shell (CS) rating system; dependent on the building use type. Retail buildings will be categorized under LEED-CS and buildings containing residences will be classified as LEED–NC.

Regardless of whether the buildings pursue LEED certification, the new buildings will be designed and constructed to meet the minimum requirements, including meeting all of the prerequisite requirements, to achieve the equivalency of LEED Silver certification.

The project will use the applicable LEED rating systems as a validation tool to check our sustainable performance but, in general, will not base design decisions strictly on achieving a specific level of LEED certification. While the design team seeks to achieve the equivalency of LEED Silver certification (50 credit points); our approach is not one of "point chasing" to maximize a LEED score. Rather we seek to design and construct a development with energy efficient sustainable buildings which collectively minimize the impact of the collective buildings on the environment and long term operating costs.

8. ***Screening:*** *Screening, such as screen plantings, shall be provided for exposed storage areas, exposed machinery installations, service areas, truck loading areas, utility buildings and structures, and similar accessory areas and structures in order to prevent their being incongruous with the existing or contemplated environment and the surrounding properties.*

   Adequate and effective screening of onsite utilities will be provided by a mix of evergreen and deciduous planting as well as architectural screens and fences. The plantings will be placed on low, mounded, graded areas where space allows. Attractive screen fences will be in keeping with the proposed site architecture

9. ***Safety:*** *With respect to personal safety, all open and enclosed spaces shall be designed to facilitate building evacuation and maximize accessibility by fire, police, and other emergency personnel and equipment.*

   Building evacuation shall be designed to meet code for egress at all levels. The site is accessible by emergency vehicles from the three entrances along Arsenal Street and the access through the adjacent Home Depot lot. Fire truck access is provided along Building A to the west by the loading area, to the south by an interior access way, to the east by the plaza area, and to the north using the existing protocol for the exiting

Mall building. Access is provided around Building's B, C and D by interior access ways to the east, west and south and to the north by Arsenal Street, and to Building E by Arsenal Street to the north, a parking area to the west, and a interior access way to the south. Building F will have fire truck access to the north, south and west by interior access ways, and to the west by the plaza area, while Building G has access from the north and east by interior access ways, to the south by Greenough Boulevard, and to the west using existing protocol for the rear of the existing Mall building. A Fire Truck Maneuvering Plan is attached.

10. ***Design:*** *Proposed developments shall seek to protect abutting properties from detrimental site characteristics resulting from proposed use, including but not limited to air and water pollution, noise, odor, heat, flood, dust vibration, lights or visually offensive structures or site features.*

    The project will be designed to protect abutting properties from detrimental site characteristics resulting from the proposed use by implementing a stormwater management system which will reduce stormwater runoff and potential flooding and water pollutants. Trash will be disposed of in closed dumpsters within a screened enclosure which will help mitigate potential odors and negative visual impacts. A mix of deciduous and evergreen trees will be used along buffered property edges. Construction related impacts, such as dust and erosion, will be mitigated through the implementation of a Stormwater Pollution Prevention Plan. Mechanical systems will be high efficiency designed to operate at 90-95% efficiency and to minimize noise levels. Garage lighting will be provided by LED fixtures with both Photocell and Occupancy Sensor control. See Context Map attached.

ATTACHMENTS:

Open Space Exhibits

Interior Open Space Exhibits

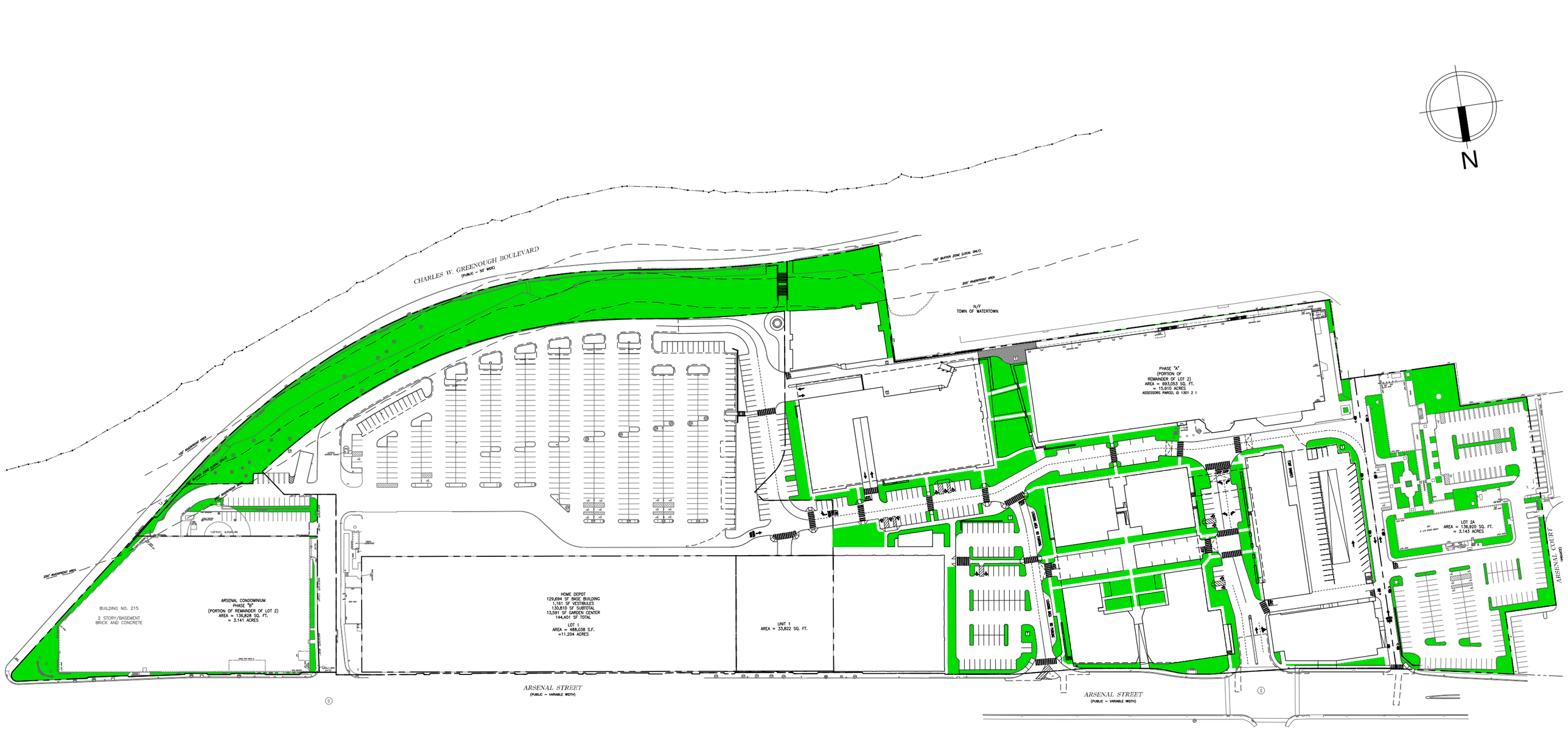
Fire Truck Maneuvering Exhibits

WB-50 Maneuvering Exhibits

Context Map

Utility Service Appendix

- *Hydrant Flow Test*
- *Sewer Flow Generation Table*
- *Sewer Meter Exhibit*
- *Sewer Flow Metering Summary And Flow Capacity Comparison*



TOTAL OPEN SPACE =
GREATER THAN 20%

RJO'CONNELL & ASSOCIATES, INC.
CIVIL ENGINEERS, SURVEYORS & LAND PLANNERS

Date: 07/11/2016 **Scale:** 1"=160'

OPEN SPACE EXHIBIT

THE ARSENAL PROJECT
WATERTOWN, MASSACHUSETTS

0 80 160 FEET

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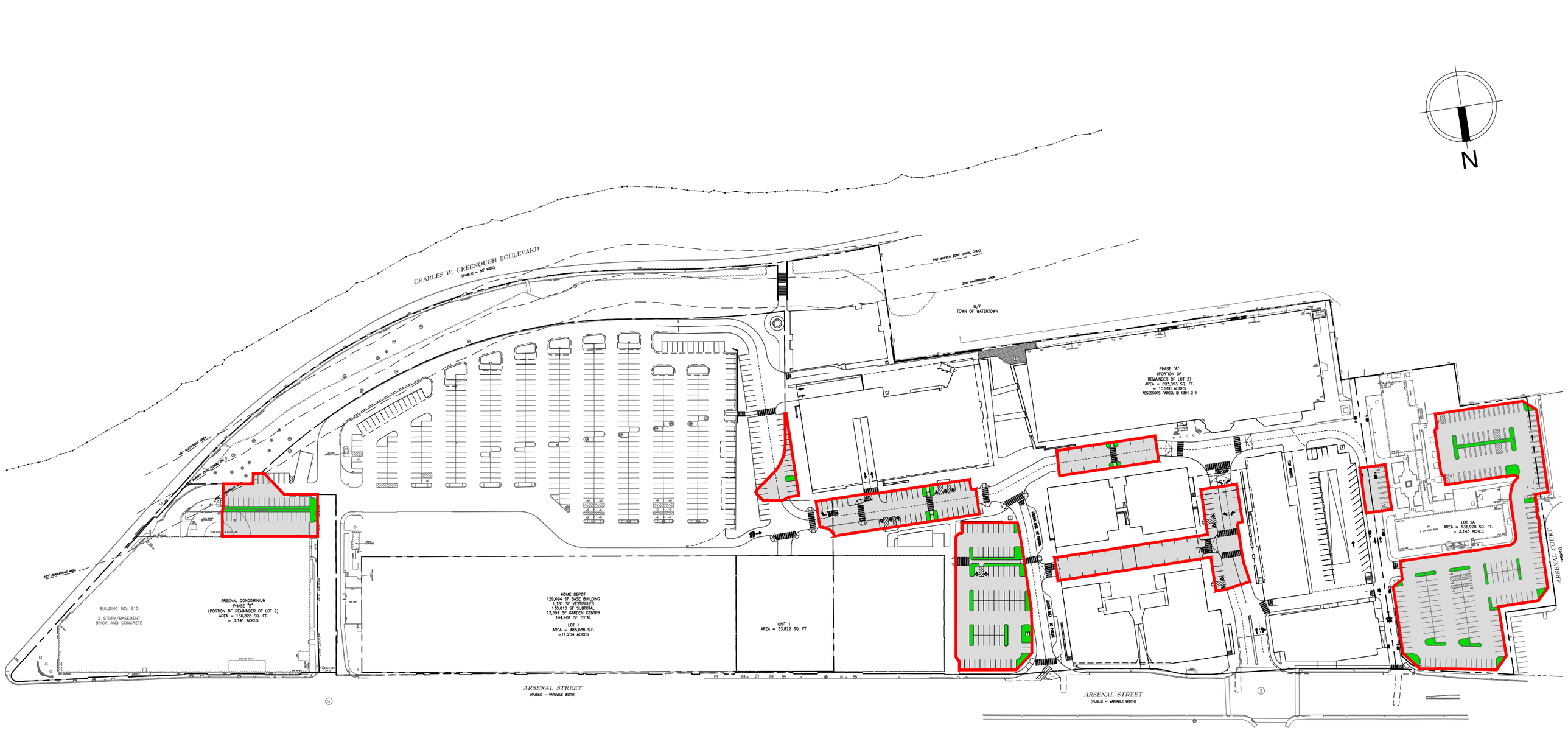

TOTAL INTERIOR OPEN SPACE =
GREATER THAN 5%

0 80 160 FEET

RJO'CONNELL & ASSOCIATES, INC.

CIVIL ENGINEERS, SURVEYORS & LAND PLANNERS

Date: 07/11/2016 **Scale:** 1"=160'

INTERIOR OPEN SPACE EXHIBIT

THE ARSENAL PROJECT
WATERTOWN, MASSACHUSETTS

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200' RIVERFRONT AREA

-RAMP-

STOP

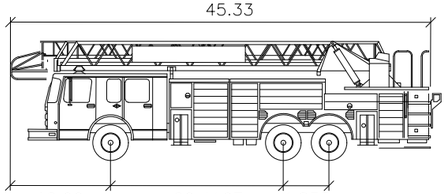
LOADING AREA NO PARKING

HOME DEPOT
129,694 SF BASE BUILDING
1,161 SF VESTIBULES
130,810 SF SUBTOTAL
13,591 SF GARDEN CENTER
144,401 SF TOTAL

ARSENAL STREET
(PUBLIC ~ VARIABLE WIDTH)

N

45.33



12.00 20.4167 4.833

Watertown Ladder Fire Tuck

Overall Length	45.333ft
Overall Width	8.000ft
Overall Body Height	11.917ft
Min Body Ground Clearance	0.627ft
Track Width	8.000ft
Lock-to-lock time	5.00s
Max Wheel Angle	45.00°

0 50 100 FEET

RJO'CONNELL & ASSOCIATES, INC.
CIVIL ENGINEERS, SURVEYORS & LAND PLANNERS

Date: 07/11/2016 Scale: 1"=100'

FIRE TRUCK TURNING EXHIBIT

THE ARSENAL PROJECT
WATERTOWN, MASSACHUSETTS

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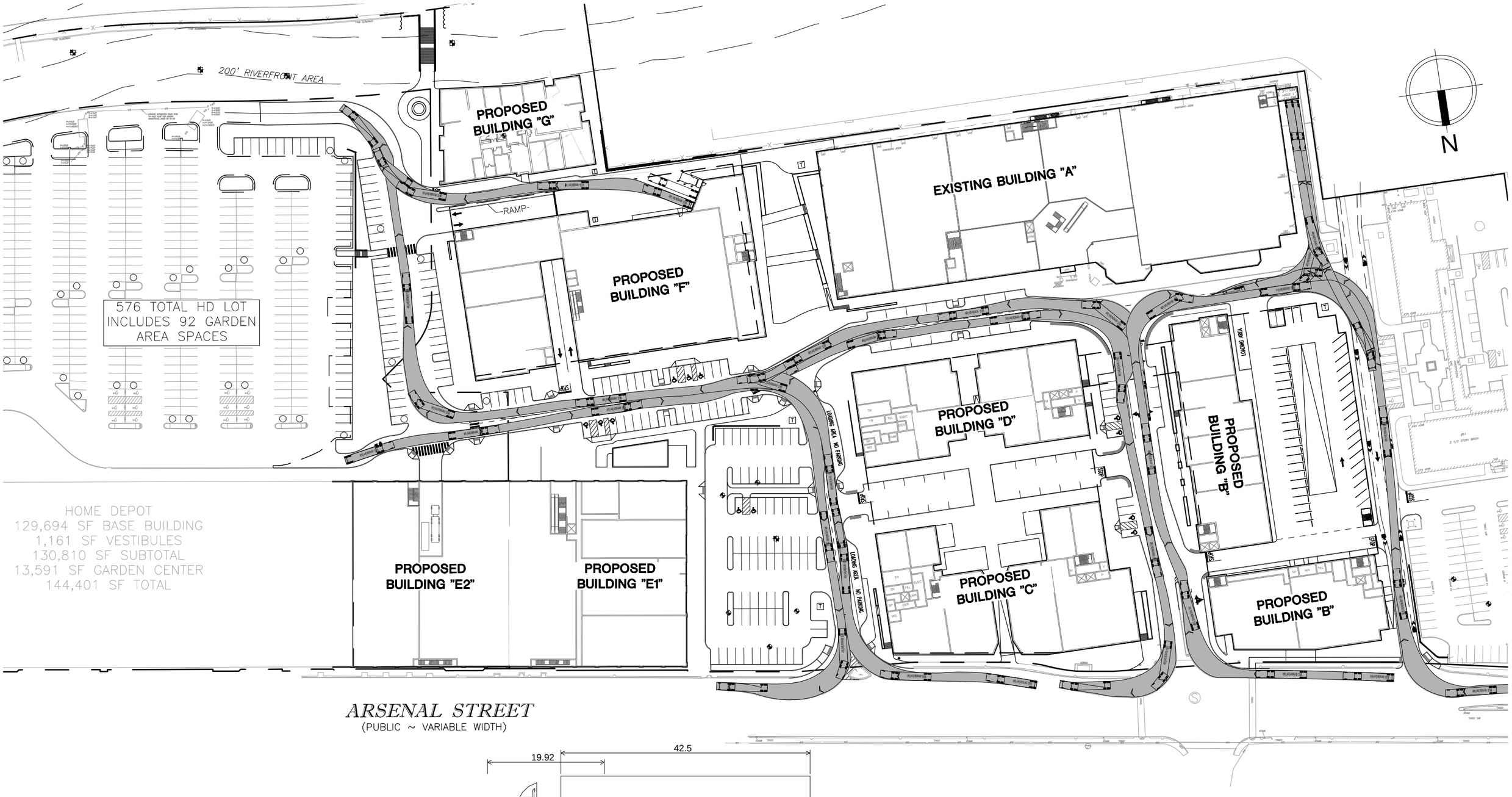

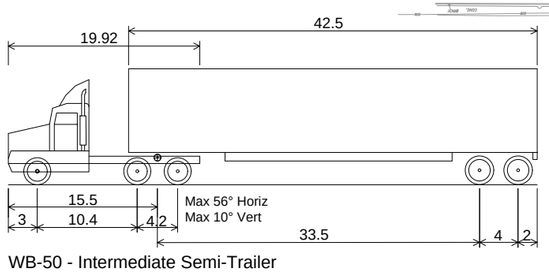

WB-50 - Intermediate Semi-Trailer

Overall Length	55.000ft
Overall Width	8.500ft
Overall Body Height	12.052ft
Min Body Ground Clearance	1.334ft
Max Track Width	8.500ft
Lock-to-lock time	6.00s
Max Steering Angle (Virtual)	17.90°

0 50 100 FEET

RJO'CONNELL & ASSOCIATES, INC.

CIVIL ENGINEERS, SURVEYORS & LAND PLANNERS

Date: 07/11/2016 Scale: 1"=100'

WB-50 TRUCK TURNING EXHIBIT

THE ARSENAL PROJECT
WATERTOWN, MASSACHUSETTS

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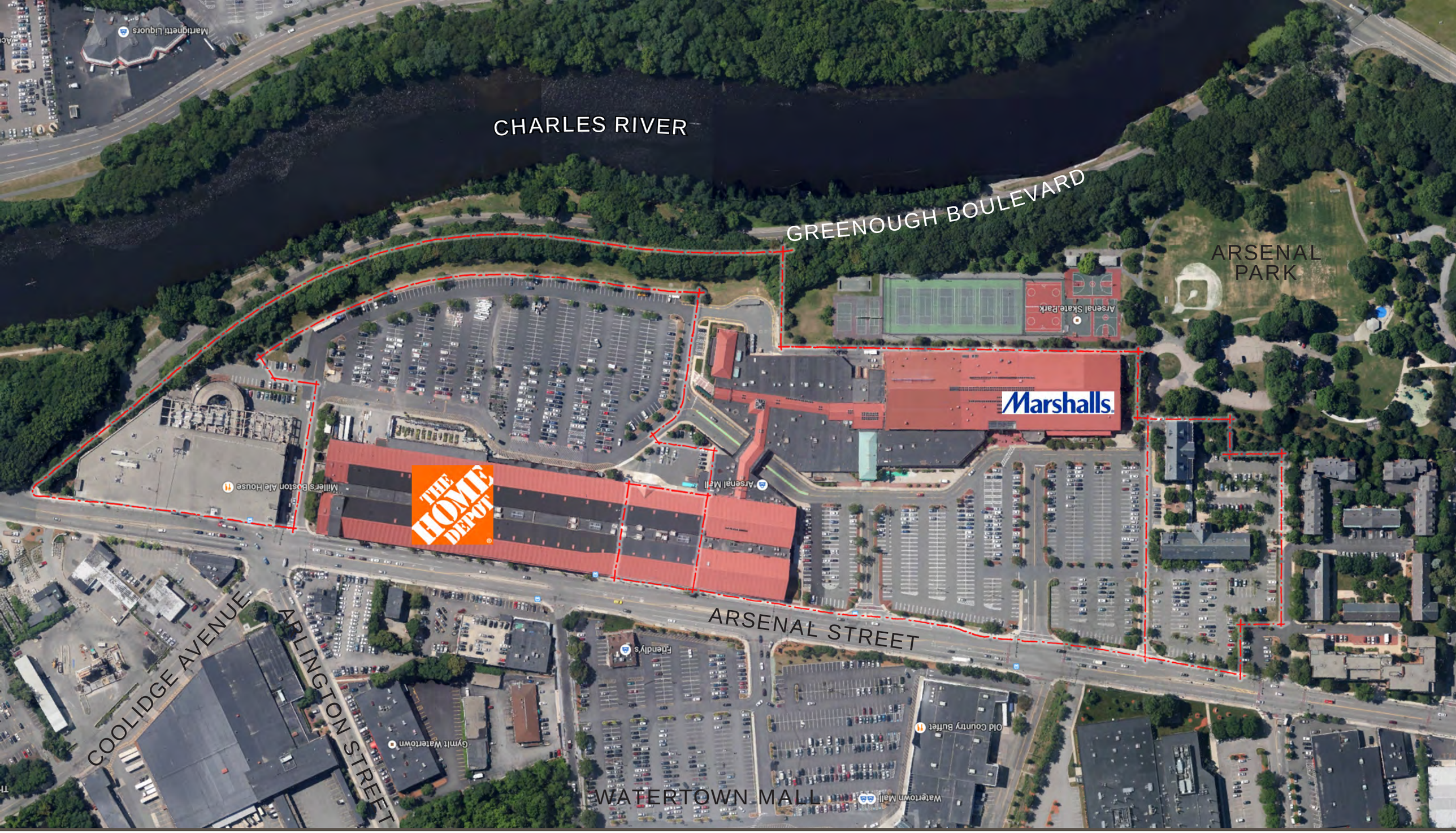


Developer:

Boylston Properties Company, Inc.

Real Estate Management & Leasing:

wilder
THE WILDER COMPANIES
DEVELOPMENT. MANAGEMENT. LEASING.

Architect:

PCA
PRELLWITZ CHILINSKI ASSOCIATES
prellwitzchilinski.com

Landscape Architect:

CRJA
landscape architects

Civil Engineer:

RJO'Connell & Associates, Inc.
Civil Engineers, Surveyors & Land Planners

Transportation Engineers:

VAI Vanasse & Associates, Inc.
Transportation Engineers & Planners

CONTEXT MAP

July 12, 2016

THE ARSENAL PROJECT

RJ O'CONNELL & ASSOCIATES, INC.
CIVIL ENGINEERS, SURVEYORS & LAND PLANNERS
80 Montvale Ave., Suite 201 Stoneham, MA 02180
Phone: 781-279-0180 Fax: 781-279-0173

Memorandum

Date: June 20, 2016

To: Roy Smith

CC: Brian Studer

From: Cory Mason, John Stoy

Regarding: Hydrant Flow Test
The Arsenal Project
Watertown, MA 02472

R.J. O'Connell & Associates, Inc. conducted two flow tests for the proposed development at The Arsenal Mall, 485 Arsenal St, Watertown, MA on the evening of June 16, 2016.

For test #1, the flow hydrant was located in a landscaped parking island north of the existing building, in the northwest portion of the site, at approximate elevation 28. The gauge hydrant was located near the drive aisle connecting the two existing parking lots, at an approximate elevation of 36.

A 1,375 gallon per minute (gpm) flow rate was observed with a 4 pounds per square inch (psi) residual drop at the gauge hydrant. The static pressure was 102 psi and the residual pressure was 98 psi.

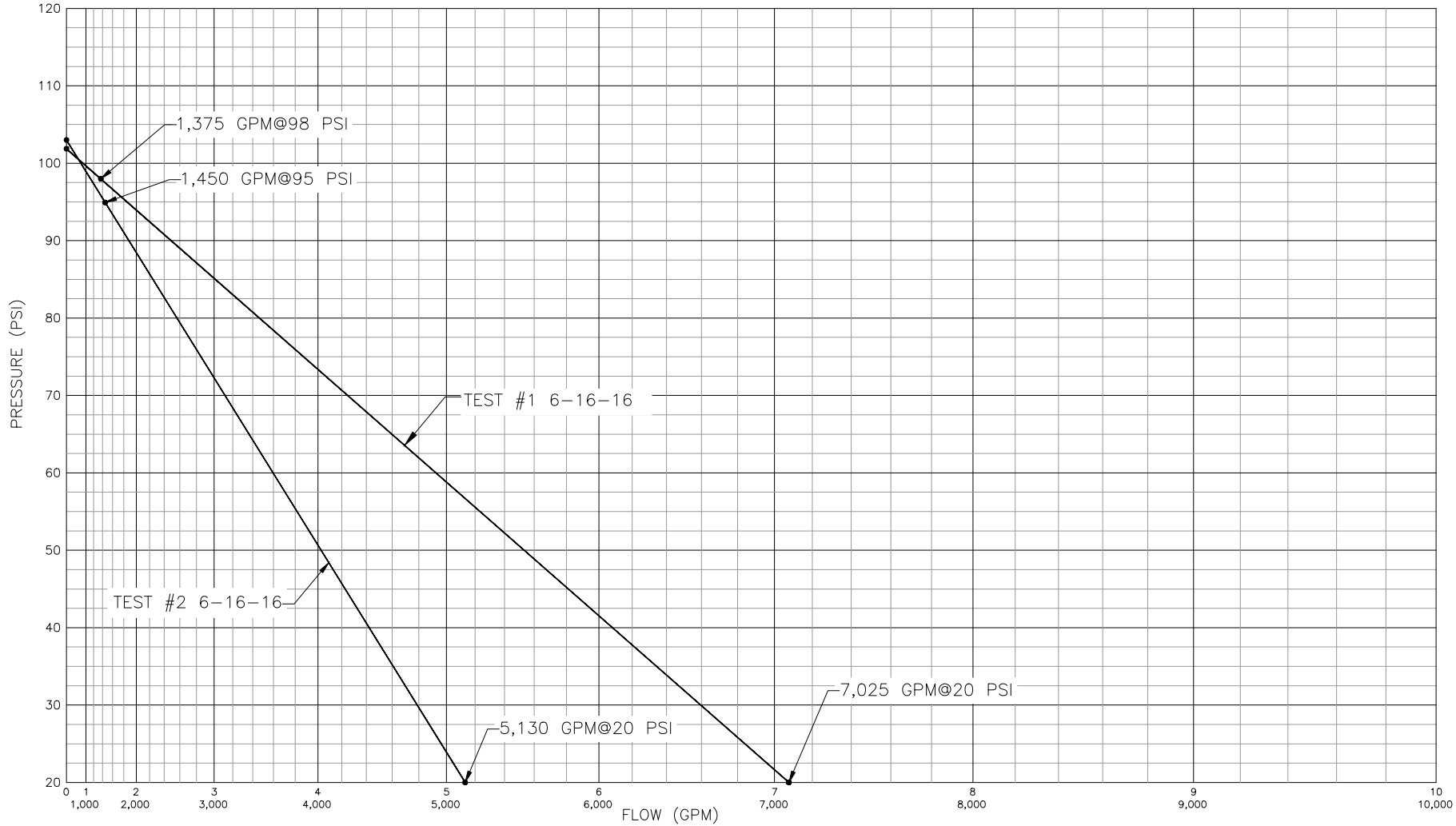
Flow calculations for test #1 result in a 7,025 gpm flow rate at 20 psi residual pressure.

For test #2, the flow hydrant was located in the grass south of the existing Home Depot parking lot at approximate elevation 27. The gauge hydrant was located in a landscaped parking island south of the Golfsmith store entrance, at an approximate elevation of 27.

A 1,450 gpm flow rate was observed with an 8 psi residual drop at the gauge hydrant. The static pressure was 103 psi and the residual pressure was 95 psi.

Flow calculations for test #2 result in a 5,130 gpm flow rate at 20 psi residual pressure.

Attachments: Hydrant Flow Test Graph, Hydrant Location Sketch



	TEST #1		TEST #2	
	FLOW HYDRANT	GAUGE HYDRANT	FLOW HYDRANT	GAUGE HYDRANT
STATIC PRESSURE(psi)	---	102	---	103
RESDIUAL PRESSURE(psi)	---	98	---	95
BASE ELEVATION(NGVD)	36'	28'	27'	27'
TEST FLOW(gpm)	1,375	---	1,450	---

Performed by: JJS/BMS/CNM
Drawn by: CNM
Checked by: RWS
Scale: N.T.S.
Date of Test: 6/16/16

Prepared by:
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781-279-0180 FAX: 781-279-0173

Project:
THE ARSENAL PROJECT
WATERTOWN, MA
Prepared for:
THE WILDER COMPANIES
BOYLSTON PROPERTIES

Drawing Name:
HYDRANT FLOW TEST
Project No: 16041

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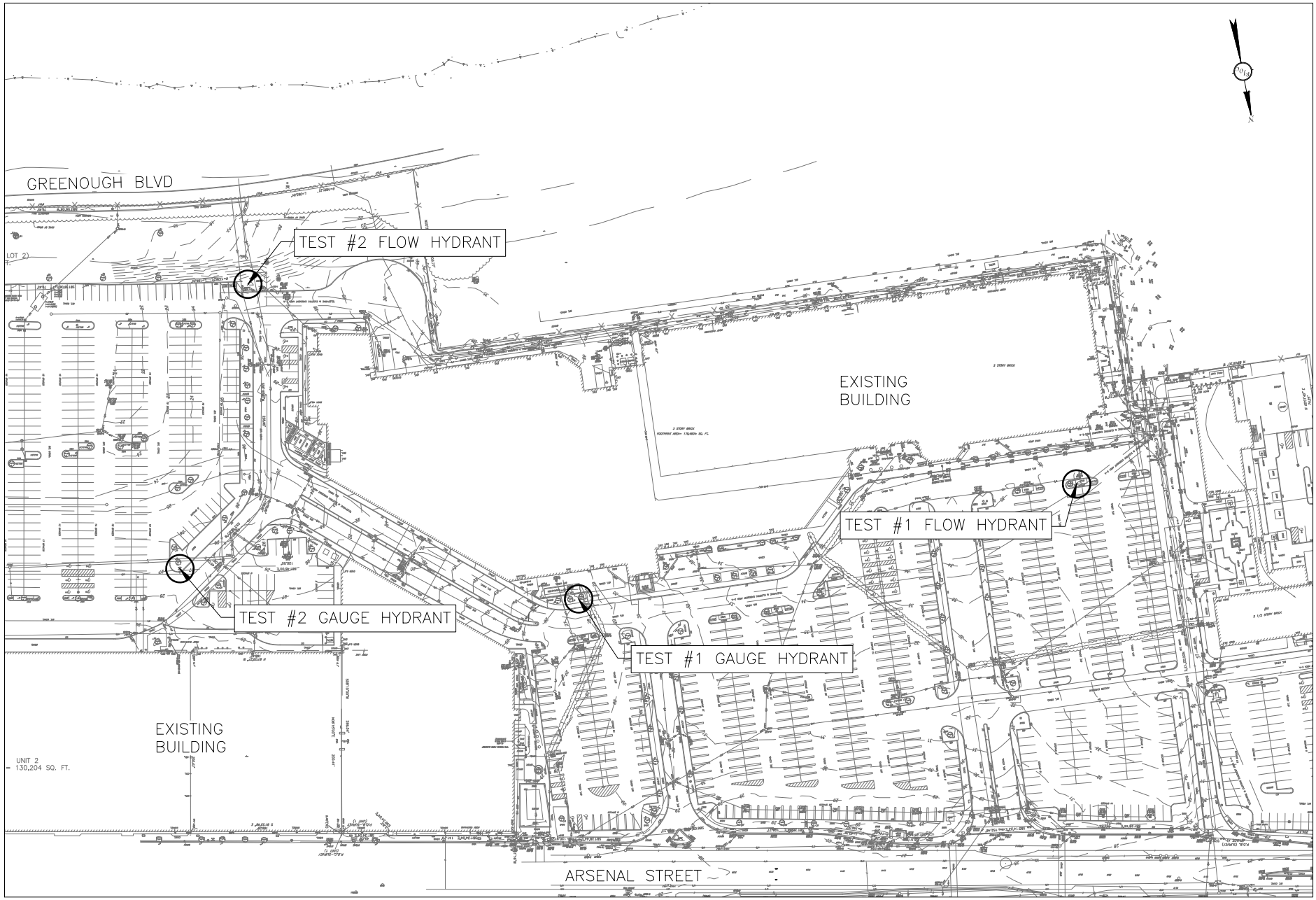
Jun 20, 2016 - 11:41am



No.	REVISION	DATE	No.	REVISION	DATE

Seal:

Designed by:	---
Drawn by:	CNM
Checked by:	RWS
Scale:	1" = 150'
Date:	6/20/2016

Prepared for:

THE WILDER COMPANIES
600 BOYLSTON STREET, SUITE 1300
BOSTON, MA 02116
PHONE: 617-437-9000

BOYLSTON PROPERTIES
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Project Name:

ARSENAL PROJECT
WATERTOWN, MA

Drawing Name:

HYDRANT FLOW TEST LOCATION PLAN

Drawing No.:

FIG. 1

Project No.: 16041

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Jun 20, 2016 - 11:38am

Job: 16041 Date: 6/14/2016

The Arsenal Project

Sewer Flow Generation Table

Draft

Building A						
Retail (1)(2)						
	Area (sf)		Flow (gpd/1,000 sf)		Total Flow (gpd)	
Floor 1	64,146		25		1,603.65	
Floor 2	52,297		25		1,307.43	
Subtotal						2,911.08 GPD
Restaurant (1)(2)(3)						
	No. of Seats		Flow (gpd/seat)		Total Flow (gpd)	
Floor 1	339	(12,171 sf)	17.5		5,932.50	
Floor 2	706	(24,020 sf)	17.5		12,355.00	
Subtotal						18,287.50 GPD
TOTAL						**21,198.58 GPD**

Building B						
Residential (1)(2)						
Type	No. of Bedrooms	No. Units	Flow per Bedroom (gpd)	Flow per Unit	Total Flow (gpd)	
1 BD, Studio	1	55	55	55	3,025	
2 BD	2	20	55	110	2,200	
3 BD	3	3	55	165	495	
Subtotal						5,720.00 GPD
Retail (1)(2)						
	Area (sf)		Flow (gpd/1,000 sf)		Total Flow (gpd)	
	24,417		25		610	
Subtotal						610.43 GPD
Restaurant (1)(2)(3)						
	No. of Seats		Flow (gpd/seat)		Total Flow (gpd)	
	393	(13,354 sf)	17.5		6,878	
Subtotal						6,877.50 GPD
TOTAL						**13,207.93 GPD**

Building C

Residential (1)(2)

Type	No. of Bedrooms	No. Units	Flow per Bedroom (gpd)	Flow per Unit	Total Flow (gpd)	
1 BD, Studio	1	90	55	55	4,950	
2 BD	2	34	55	110	3,740	
3 BD	3	4	55	165	660	
Subtotal						9,350.00 GPD

Retail (1)(2)

	Area (sf)		Flow (gpd/1,000 sf)	Total Flow (gpd)	
	15,524		25	388	
Subtotal					388.10 GPD

Restaurant (1)(2)(3)

	No. of Seats		Flow (gpd/seat)	Total Flow (gpd)	
	373	(12,675 sf)	17.5	6,528	
Subtotal					6,527.50 GPD
TOTAL					**16,265.60 GPD**

Building D

Residential (1)(2)

Type	No. of Bedrooms	No. Units	Flow per Bedroom (gpd)	Flow per Unit	Total Flow (gpd)	
1 BD, Studio	1	67	55	55	3,685	
2 BD	2	22	55	110	2,420	
3 BD	3	1	55	165	165	
Subtotal						6,270.00 GPD

Retail (1)(2)

	Area (sf)		Flow (gpd/1,000 sf)	Total Flow (gpd)	
	15,915		25	398	
Subtotal					397.88 GPD

Restaurant (1)(2)(3)

	No. of Seats		Flow (gpd/seat)	Total Flow (gpd)	
	142	(4,834 sf)	17.5	2,485	
Subtotal					2,485.00 GPD
TOTAL					**9,152.88 GPD**

Building E1					
Retail (1)(2)					
	Area (sf)		Flow (gpd/1,000 sf)	Total Flow (gpd)	
	30,088		25	752	
Subtotal					752.20 GPD
Restaurant (1)(2)(3)					
	No. of Seats		Flow (gpd/seat)	Total Flow (gpd)	
	144	(4,896 sf)	17.5	2,520	
Subtotal					2,520.00 GPD
TOTAL					**3,272.20 GPD**

Building E2					
Theater (1)(2)					
	No. of Seats		Flow (gpd/seat)	Total Flow (gpd)	
	900	(33,822 sf)	3	2,700	
TOTAL					**2,700.00 GPD**

Building F						
Residential (1)(2)						
Type	No. of Bedrooms	No. Units	Flow per Bedroom (gpd)	Flow per Unit	Total Flow (gpd)	
1 BD, Studio	1	44	55	55	2,420	
2 BD	2	16	55	110	1,760	
3 BD	3	0	55	165	0	
Subtotal						4,180.00 GPD
Retail (1)(2)						
	Area (sf)		Flow (gpd/1,000 sf)		Total Flow (gpd)	
	7,169		25		179	
Subtotal						179.23 GPD
Restaurant (1)(2)(3)						
	No. of Seats		Flow (gpd/seat)		Total Flow (gpd)	
	213	(7,235 sf)	17.5		3,728	
Subtotal						3,727.50 GPD
Supermarket (1)(2)						
	Area (sf)		Flow (gpd/1,000 sf)		Total Flow (gpd)	
	25,000		48.5		1,213	
Subtotal						1,212.50 GPD
TOTAL						**9,299.23 GPD**

Building G						
Residential (1)(2)						
Type	No. of Bedrooms	No. Units	Flow per Bedroom (gpd)	Flow per Unit	Total Flow (gpd)	
1 BD, Studio	1	112	55	55	6,160	
2 BD	2	35	55	110	3,850	
3 BD	3	3	55	165	495	
TOTAL						**10,505.00 GPD**

SITE TOTAL*	**85,601.40 GPD**

*Does not include Home Depot, HVMA, or Arsenal Condominium Building No. 215

NOTES:

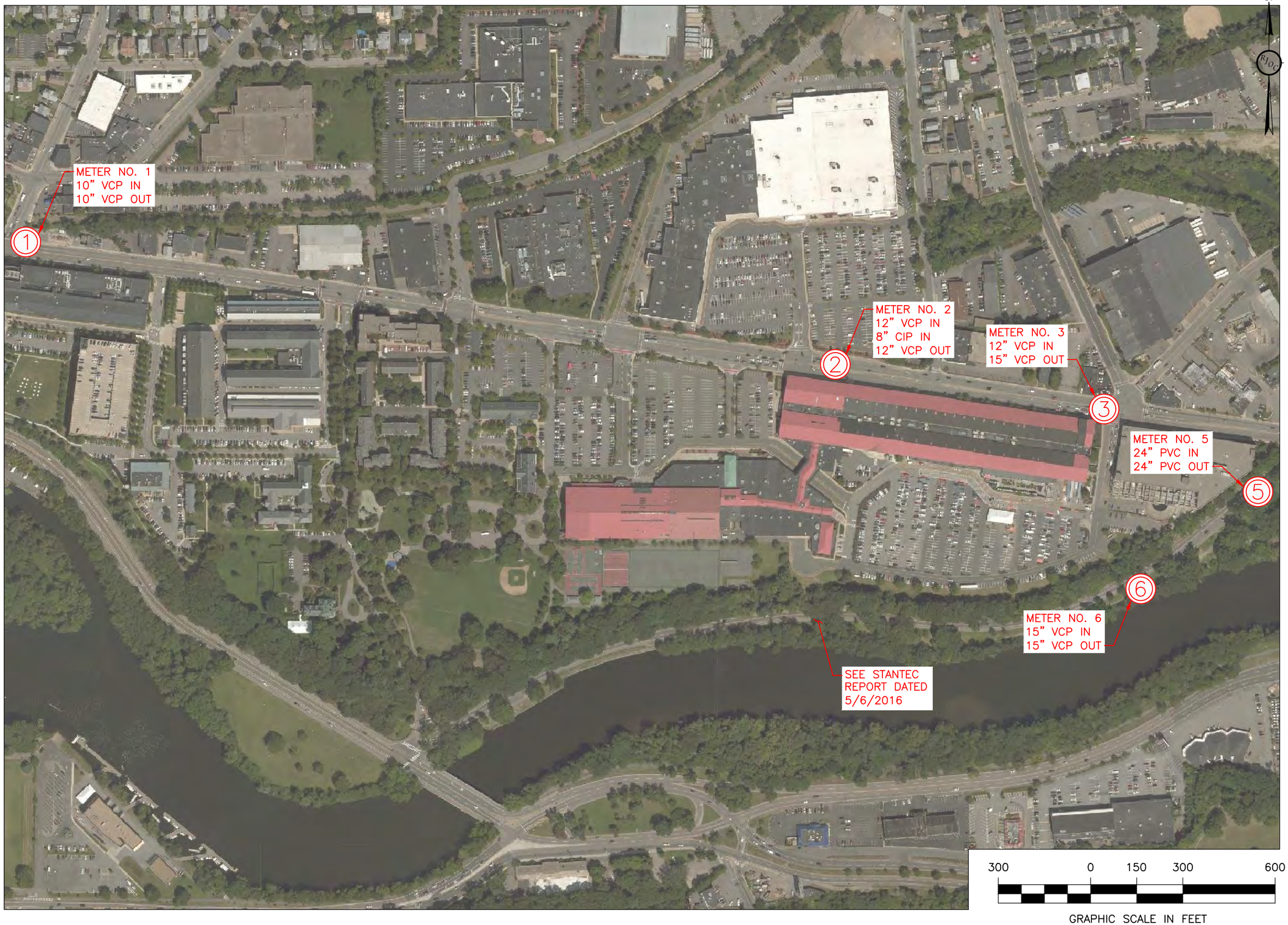
1. Title V Design Flows per Type:

Retail =	50	GPD per 1,000 sf
Supermarket =	97	GPD per 1,000 sf
Restaurant =	35	GPD per seat
Theater =	3	GPD per seat
Residential =	110	GPD per bedroom

GPD = gallons per day

2. 50% of Title V design flows were used to estimate actual proposed flows.

3. Assume 34 sf per each restaurant seat. (77,000 sf restaurant area / 2,275 restaurant seats)



No.	Revision	Date

Designed by:	---
Drawn by:	CNM
Checked by:	RWS
Scale:	1"=300'
Date:	06/16/2016

Prepared For:

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Prepared By:

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Project Name:

THE ARSENAL PROJECT
WATERTOWN, MA

Drawing Name:

SEWER METER EXHIBIT

Drawing No.:

EX-1

Project No.: 16041

Drawing name: G:\MA\Watertown\Boylston Properties\Arsenal Mall\Exhibits\16041_Sewer Meter Exhibit.dwg
Jun 16, 2016 - 14:13pm

Project: 16041 Date: 6/16/2016

The Arsenal Project

Sewer Flow Metering Summary and Flow Capacity Comparison

Off-site Meter No.	Pipe Size (in)	Peak Flow Depth** (in)	Minimum Existing Daily Flow (gpd)	Average Existing Daily Flow (gpd)	Peak Existing Daily Flow (gpd)	Proposed Additional Daily Flow (gpd)	Peak Proposed Flow Rate* (gpd)	Sewer Full Flow Capacity (gpd)	Sewer Half Full Capacity (gpd)
1	10	---	5,000	62,000	153,000	0	153,000	N/A	N/A
2	12	4.67	11,000	69,000	161,000	53,898	376,592	1,169,750	585,000
3	12	5.48	24,000	113,000	286,000	53,898	501,592	1,169,750	585,000
3A	24	11.71	102,000	517,000	1,031,000	53,898	1,246,592	2,577,200	1,288,600
5	24	7.82	102,000	517,000	1,031,000	53,898	1,246,592	5,318,800	2,659,400
6	15	6.18	28,000	110,000	290,000	31,704	416,816	1,620,000***	810,000***

*Peak Proposed Flow Rate = Peak Existing Flow Rate + Proposed Additional Daily Flow with an applied peaking factor of 4

**Peak Flow Depth = Flow Depth in sewer for Peak Proposed Flow Rate

***From Stantec Report dated 5/6/2016

Project No. 16041
Project: TAP
Date: 6-14-16 Sheet 1 of ____
Subject: SEWER CAPACITIES - FULL
Designed By: JTB

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CAPACITY OF 12-INCH SEWER IN ARSENAL STREET @ (2)

GIVEN: SEWER SLOPE, $S = 0.003$ ft./ft.
HYDRAULIC RADIUS, $r = 0.25$ ft.
ROUGHNESS COEFFICIENT, $n = 0.013$ (VITRIFIED CLAY PIPE)
CROSS-SECTIONAL AREA, $A = 0.785\ ft^2$

VELOCITY, V_{FULL}

$$V_{FULL} = \frac{1.486}{n} \times S^{1/2} \times r^{2/3}$$

$$V_{FULL} = \frac{1.486}{0.013} \times 0.003^{1/2} \times 0.25^{2/3} = 2.49\ ft/sec.$$

CAPACITY, Q_{FULL}

$$Q_{FULL} = AV = 0.785\ ft^2 \times 2.49\ ft/sec = 1.95\ ft^3/sec$$

$1.95\ ft^3/sec = \underline{1.26\ mgd}$ (1,260,000 gpd)

CAPACITY OF 12-INCH SEWER IN ARSENAL STREET @ (3)

GIVEN: SEWER SLOPE, $S = 0.0026$ ft/ft.
HYDRAULIC RADIUS, $r = 0.25$ ft.
ROUGHNESS COEFFICIENT, $n = 0.013$ (VITRIFIED CLAY PIPE)
CROSS-SECTIONAL AREA, $A = 0.785\ ft^2$

VELOCITY, V_{FULL}

$$V_{FULL} = \frac{1.486}{0.013} \times 0.0026^{1/2} \times 0.25^{2/3} = 2.31\ ft/sec.$$

Project No. 16041
Project: TAP
Date: 6-14-16 Sheet 2 of ____
Subject: SEWER CAPACITIES
Designed By: JJS

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CAPACITY, Q_{FULL}

$Q_{FULL} = AV = 0.785 ft^2 \times 2.31 ft/sec = 1.81 ft^3/sec$

$1.81 ft^3/sec = \underline{1,169,752 gpd}$ (1.17 mgd)

CAPACITY OF 24-INCH SEWER IN ARSENAL STREET @ (3A)

GIVEN: SEWER SLOPE, $S = 0.0008$ ft/ft (MINIMUM ASSUMED)
HYDRAULIC RADIUS, $r = 0.25$ ft.
ROUGHNESS COEFFICIENT, $n = 0.013$ (VITRIFIED CLAY PIPE)
CROSS-SECTIONAL AREA, $A = 3.14 ft^2$

VELOCITY, V_{FULL}

$V_{FULL} = \frac{1.486}{0.013} \times 0.0008^{1/2} \times 0.25^{2/3} = 1.27$ ft/sec

CAPACITY, Q_{FULL}

$Q_{FULL} = AV = 3.14 ft^2 \times 1.27 ft/sec = 3.99 ft^3/sec.$

$3.99 ft^3/sec = \underline{2,577,200 gpd}$ (2.6 mgd)

CAPACITY OF 24-INCH SEWER IN GREENOUGH BLVD. @ (5)

GIVEN: SEWER SLOPE, $S = 0.0008$ (MINIMUM ASSUMED)
HYDRAULIC RADIUS, $r = 0.50$
ROUGHNESS COEFFICIENT, $n = 0.01$ (PVC PIPE)
CROSS-SECTIONAL AREA, $A = 3.14$

Project No. 16041
Project: TAP
Date: 6-15-16 Sheet 3 of ____
Subject: SEWER CAPACITIES
Designed By: ____

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VELOCITY, V_{FULL}

$$V_{FULL} = \frac{1.486}{0.01} \times 0.0008^{1/2} \times 0.5^{2/3} = 2.62 \text{ ft/sec}$$

CAPACITY, Q_{FULL}

$$Q_{FULL} = AV = 3.14 \text{ ft}^2 \times 2.62 \text{ ft/sec} = 8.23 \text{ ft}^3/\text{sec}$$

$8.23 \text{ ft}^3/\text{sec} = \underline{5,318,818 \text{ gpd}}$ (5.32 mgd)

Project No. 16041
Project: TAP
Date: 6-15-16 Sheet 1 of 4
Subject: PEAK FLOW DEPTH
Designed By: JJS

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FLOW DEPTH IN 12" SEWER IN ARSENAL STREET @ PEAK PROPOSED FLOW RATE @ (2)

GIVEN: PEAK PROPOSED FLOW = 376,592 gpd = 0.583 ft^3/sec
SEWER FULL FLOW CAPACITY = 1,169,750 gpd = 1.81 ft^3/sec

$$\frac{q}{Q_{FULL}} = \frac{0.583}{1.81} = 0.322$$

FROM TABLE 14-3, $\frac{d}{D} = 0.389$

$\frac{d}{1.0'} = 0.389$ $\quad \frac{1}{2}D = 6.0"$

$d = 0.389 \times 1.0' = 0.389' = \underline{4.67"} < 6"$ OK

FLOW DEPTH IN 12" SEWER IN ARSENAL STREET @ PEAK PROPOSED FLOW RATE @ (3)

GIVEN: PEAK PROPOSED FLOW = 501,592 gpd = 0.78 ft^3/sec
SEWER FULL FLOW CAPACITY = 1,169,750 = 1.81 ft^3/sec

$$\frac{q}{Q_{FULL}} = \frac{0.78}{1.81} = 0.43$$

FROM TABLE 14-3, $\frac{d}{D} = 0.457$

$\frac{d}{1.0} = 0.457$ $\quad \frac{1}{2}D = 6.0"$

$d = 0.457 \times 1.0' = 0.457' = \underline{5.48"} < 6.0"$ OK

Project No. 16041
Project: TAP
Date: 6-15-16 Sheet 2 of 4
Subject: PEAK FLOW DEPTHS
Designed By:

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FLOW DEPTH IN 24" SEWER IN GREENOUGH BLVD. @ PEAK PROPOSED FLOW RATE @ (5)

GIVEN: PEAK PROPOSED FLOW = 1,246,592 gpd = 1.93 ft³/sec
SEWER CAPACITY = 5,318,800 gpd = 8.23 ft³/sec

$$\frac{q}{Q_{FULL}} = \frac{1.93}{8.23} = 0.233$$

FROM TABLE 14-3, $\frac{d}{D} = 0.326$

$\frac{d}{2.0'} = 0.326$, $\frac{1}{2}D = 12"$

$d = 0.326 \times 2' = 0.652' = \underline{\underline{7.82"}} < 12"$ OK

FLOW DEPTH IN 24" SEWER IN ARSENAL STREET @ PEAK PROPOSED FLOW RATE @ (3A)

GIVEN: PEAK PROPOSED FLOW = 1,246,592 gpd = 1.93 ft³/sec
SEWER CAPACITY = 2,577,200 gpd = 3.99 ft³/sec

$$\frac{q}{Q_{FULL}} = \frac{1.93}{3.99} = 0.48$$

FROM TABLE 14-3, $\frac{d}{D} = 0.488$

$\frac{d}{2.0} = 0.488$, $\frac{1}{2}D = 12"$

$d = 0.488 \times 2.0' = 0.976' = 11.71" < 12"$ OK

Project No. 16041
Project: TAP
Date: 6-15-16 Sheet 3 of 4
Subject: PEAK FLOW DEPTHS
Designed By:

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FLOW DEPTH IN 15" SEWER IN GREENOUGH BLVD @ PEAK PROPOSED FLOW RATE @ (6)

GIVEN: PEAK PROPOSED FLOW = 416,816 gpm = 0.645 ft³/sec
SEWER CAPACITY = 1,620,000 gpm = 1.81 ft³/sec

$$\frac{q}{Q} = \frac{0.645}{1.81} = 0.356$$

FROM TABLE 14-3, $\frac{d}{D} = 0.412$

$\frac{d}{1.25'} = 0.412$, $1/2\ D = 7.5"$

$d = 0.412 \times 1.25' = 0.515' = \underline{6.18"} < 7.5"$

Project No. 16041
Project: THE ARSENAL PROJECT
Date: 6-30-16 Sheet 4 of 4
Subject: ALL PROJECT SEWAGE TO ARSENAL ST.
Designed By: FTS

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FLOW DEPTH IN 12" SEWER IN ARSENAL STREET @ PEAK PROPOSED FLOW RATE @ METER LOCATION (3)

GIVEN: PEAK PROPOSED FLOW = 587,240 gpd* = 0.91 ft³/sec
FULL FLOW CAPACITY OF SEWER = 1,169,750 gpd = 1.81 ft³/sec

$$\frac{q}{Q_{FULL}} = \frac{0.91}{1.81} = 0.501$$

FROM TABLE 14-3:

$$\frac{d}{D} = 0.50 \qquad 1/2\,D = 6.0"$$

$d = 0.50(1.0') = 0.5' = 6" = 1/2D$ OK

* PEAK EXISTING DAILY FLOW @ (3) = 286,000 gpd
PEAK PROPOSED FLOW = (85,601 − 10,291) × 4 = 301,240 gpd

PEAK PROPOSED FLOW = 587,240 gpd

Table 14-3 Hydraulic Elements of a Sewer of Circular Cross-Section

(Uncorrected for variations in roughness with depth)

Central angle: $\cos \frac{1}{2}\theta = 1 - 2d/D$

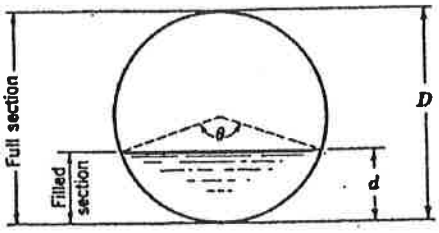
Area: $\frac{D^2}{4}\left(\frac{\pi\theta}{360} - \frac{\sin\theta}{2}\right)$

Wetted perimeter: $\pi D\theta/360$

Hydraulic radius:

$$\frac{D}{4}\left(1 - \frac{360 \sin\theta}{2\pi\theta}\right)$$

Velocity: $\frac{1.49}{n} r^{2/3} s^{1/2}$



Depth d/D (1)	Area a/A (2)	Hydraulic Radius r/R (3)	R/r (4)	$(r/R)^{1/6}$ (5)	Velocity v/V for $N/n = 1.0$ (6)	Discharge q/Q (7)	Roughness N/n (8)
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.00
0.900	0.949	1.192	0.839	1.030	1.124	1.066	0.94
0.800	0.858	1.217	0.822	1.033	1.140	0.988	0.88
0.700	0.748	1.185	0.843	1.029	1.120	0.838	0.85
0.600	0.626	1.110	0.900	1.018	1.072	0.671	0.83
0.500	0.500	1.000	1.00	1.000	1.000	0.500	0.81
0.400	0.373	0.857	1.17	0.975	0.902	0.337	0.79
0.300	0.252	0.684	1.46	0.939	0.776	0.196	0.78
0.200	0.143	0.482	2.07	0.886	0.615	0.088	0.79
0.100	0.052	0.254	3.94	0.796	0.401	0.021	0.82
0.000	0.000	...	...	...	...	0.000	...